CLAIMS

1. A method of manufacturing a photonic integrated circuit comprising a compound semiconductor structure having a quantum well region, comprising the steps of irradiating the structure using a source of photons to generate defects, the photons having an energy (E) at least that of the displacement energy (E_D) of at least one element of the compound semiconductor, and subsequently annealing the structure to promote quantum well intermixing.

2. A method according to claim 1, in which the radiation source is a plasma.

3. A method according to claim 2, in which the plasma source is generated using an electron cyclotron resonance (ECR) system, an inductively coupled plasma (ICP) system, a plasma disk excited by a soft vacuum electron beam, or plasma soft x-ray (SFR) devices.

4. A method according to claim 1, in which the radiation source is one selected from a group consisting of electrical gas discharge devices, excimer lasers, synchrotron devices, flash x-ray devices and gamma ray sources.

Sub A1

5. A method according to any preceding claim, including the step of masking a portion of the structure to control the degree of radiation damage.

6. A method according to claim 5, in which the mask is adapted to prevent intermixing entirely.

7. A method according to claim 5, in which the structure is masked in a differential manner to selectively intermix the structure in a spatially controlled manner by

controlling the exposure of portions of the structure in a predetermined manner.

8. A method according to any of claims 5 to 7, in which the mask is selected from a group consisting of binary masks, phase masks, gray masks, dielectric or metal masks, and photoresist masks.

Sub A2

9. A method according to any preceding claim, in which spatial control of intermixing is controlled using a variable profile mask pattern.

10. A method according to any preceding claim further comprising the steps of forming a photoresist on the structure and differentially exposing regions of the photoresist in a spatially selective manner in dependence on the degree of quantum well intermixing required, and subsequently developing the photoresist.

11. A method according to claim 10, comprising the step of applying an optical mask to the photoresist and exposing the photoresist through the optical mask, the optical mask having an optical transmittance that varies in a spatially selective manner.

12. A method according to claims 11, in which the optical mask is a Gray scale mask.

Sub A3

13. A method according ~~to any~~ of claims 10 to 12, in which the ~~photo~~resist is applied to a masking layer.

14. A method according to claim 13, in which the masking layer is a dielectric.

Sub A4

15. A method ~~according to~~ claims 13 or 14, further ~~comprising~~ the step of etching the structure with the

developed photoresist in situ to provide a differentially etched masking layer.

Sub A4

16. A method according to any preceding claim, in which an electron cyclotron resonance system is used to generate a plasma, wherein the microwave power of the ECR system is between 300 and 3000 W, more preferably between 1000 and 2000 W, the process temperature is between 25 and 500°C, more preferably between 25 and 200°C, the process pressure is between 0.1 and 100 mTorr, more preferably between 20 and 50 mTorr, and the exposure time is between 30 seconds and 1 hour, more preferably between 4 and 14 minutes.